

MILITARY SMALL GROUP PERFORMANCE UNDER  
ISOLATION AND STRESS

CRITICAL REVIEW

III. ENVIRONMENTAL STRESS AND BEHAVIOR ECOLOGY

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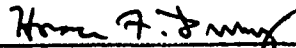
## FOREWORD

This review is part of a bibliographic study of research on factors related to the effectiveness of Aircraft Control and Warning (AC&W) sites in Alaska. The literature surveyed has previously been summarized in a series of annotated bibliographies (Reports AAL TR 61-19 to 61-24). The critical reviews based on this literature have been prepared as a series of five reports, covering the following topics: I. Informal, Natural Groups: Development, Structure, and Function; II. Dimensions of Group Structure and Group Behavior; III. Environmental Stress and Behavior Ecology; IV. Organizational Staffing; and V. Psychological Principles of Management and Leadership. The assistance of Mr. George Haven is acknowledged in the preparation of these reviews.

## ABSTRACT

A critical research review of behavioral effects of isolation, cold, and general stress, with particular reference to AC&W sites in Alaska. On the basis of the literature, environmental stress does not appear as a major threat to adjustment of troops stationed at AC&W sites. Human engineering has contributed greatly to the comfortization and control of the environment, and there appears to be a wide difference between conditions of the area and conditions of the specific work and living environment, except in cases of emergency. The possibility of such emergencies may be a threat, but few have occurred. The positive values of motivation, training, and group dynamics (including leadership) as factors which offset the disorganizing effects of environmental stress are pointed out.

## PUBLICATION REVIEW



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## MILITARY SMALL GROUP PERFORMANCE UNDER ISOLATION AND STRESS - CRITICAL REVIEW

### III. ENVIRONMENTAL STRESS AND BEHAVIOR ECOLOGY

#### SECTION 1. INTRODUCTION

This report presents a selective review of research on the effects of environmental stress on individual and group performance with particular reference to the conditions experienced by Air Force personnel at AC&W sites in Alaska. An annotated bibliography, with abstracts of selected studies in this area, has been published in an earlier report of this project (44).

The literature on adaptation of men and equipment to cold weather conditions is largely confined to biological and medical research, both in the laboratory and in the field. There is a substantial amount of psychological research on "stress," including isolation (4, 11, 20, 22, 29, 34, 37, 50), but most of this work has restricted relevance to the present problem. Psychological research on Arctic problems is surprisingly limited, particularly in view of the current importance of Arctic (and Antarctic) operations. As recently as 1960, Philip Law (33), an Australian Antarctic expert with experience in 30 polar expeditions, remarked on the dearth of psychological information in the polar literature. The Arctic Bibliography (3) of the Arctic Institute of North America, covering the years 1947 to 1959, contains 43,640 references, but very little of a psychological nature. Edgerton, et al., (17), in 1953, found less than 200 articles sufficiently pertinent for inclusion in their study of personnel factors in polar operations, after reviewing American, Canadian and British research and naturalists' reports.

In the preparation of this review, emphasis has been placed

on empirical investigations in preference to observational and anecdotal reports. As a result, some topics that should be included, such as effects of prolonged day and night, whiteout, glare, and others are omitted. The list of references includes several general bibliographies and review articles.

On the basis of the literature reviewed, environmental stress does not appear as a major threat to adjustment of troops stationed at AC&W sites. Human engineering has contributed greatly to the comfortization and control of the environment and there appears to be a wide difference between conditions of the area and conditions of the specific work and living environment, except in cases of emergency. The possibility of such emergencies may be a threat, but few have occurred. The positive values of motivation, training, and group dynamics (including leadership) in offsetting the disorganizing effects of environmental stress are pointed out.

The discussion is in four parts: (1) ecological dimensions of isolation; (2) adaptation and adjustment to cold; (3) a brief survey of stress concepts and stress research; and (4) some results of morale surveys among personnel exposed to isolation, cold, and stress.

## SECTION 2. ISOLATION

The analysis of isolation phenomena involves three separate, but related modes of isolation: confinement, separation from valued stimuli, and reduction of sensory stimulation (44). This classification is convenient for grouping the published studies.

### Confinement to a Limited Space

The essential aspect of this mode of isolation is the restraint of freedom of movement, and most reports agree that it is a serious source of strain.

Biderman (6) discussed this mode in relation to problems involved in fallout shelters, where freedom of movement is necessarily limited. He pointed out that inactivity, boredom, and monotony increase distress and discomfort from many sources. He also mentioned that this generalization has greater relevance to persons who are well-fed and possess a surplus of energy beyond that required to sustain existence than it does to starved, exhausted, or debilitated persons.

Gaito, et al., (21) at the Air Crew Equipment Laboratory (Naval Air Materiel Center, Philadelphia) studied experimentally the effects of confinement and crowding in a small space. Six young men were confined in a small chamber for seven days. As the experimental period continued, performance on various psychomotor tasks decreased in efficiency and accuracy, while tests of judgment, learning, and reasoning showed no decrement. Morale was initially very high, but dropped drastically after a few days.

Kinsey and Murphree (32) found that some individuals in the submarine service have shown claustrophobic responses to confinement, especially in escape training.

Jones (30) has advanced some evidence to indicate that people

who have trouble with authority are more prone to trouble in confinement. This may include people who rebel against authority, or who cling to it.

Wexler, et al. (48) confined subjects individually in a tank-type respirator for periods of up to 36 hours. They reported that:

"Though there was considerable variation in individual responses, all (17) subjects showed impaired ability to concentrate, distortions in time judgment, and degrees of anxiety. Eight had psychosomatic delusions, illusions, or hallucinations."

Rohrer (40, 41), describing men at Antarctic stations, noted that as the "deepfreeze" winter approached, signs of depression appeared. In accounting for this he emphasized the limitations on work activities as a result of the low temperatures and darkness. It is likely that the confinement and decreased freedom of movement brought about by these conditions may also be a contributory factor.

#### Separation from Valued Stimuli

Grinker and Spiegel (23), writing of Men Under Stress, described this stress pointedly, as follows:

"The thought of home intrudes itself disagreeably on the soldier's mind when there are special causes for worry which increase his preoccupation with the subject and decrease his fighting efficiency. Lack of mail, worrisome letters, suspicion of wives unfaithfulness, broken engagements, financial troubles and a host of other problems far away at home make the flier feel helpless and impotent in solving his important personal problems and stimulate his anxiety and insecurity. These create powerful forces that augment thoughts of home till they become persistent obsessions."

In such cases enforced separation frustrates the desire to cope with problems at home. This type of problem is not uniquely associated with remote sites, but may apply to any situation away from home. Nevertheless, the remoteness, in association with other unpleasant aspects of weather, cold, long nights, and confinement, may intensify the problems.

Gross and Miller (24) distinguished between the geographic aspects of isolation (being far from surrounding towns) and cultural aspects (being located in an alien culture). Both aspects involve a separation from the usually valued stimuli for an individual. Chance (10) has written of the rapid cultural changes in Eskimo villages in regions of DEW line installations. Although such changes will operate to make the regions surrounding these installations somewhat less alien to site personnel, profound differences will still exist between such regions and those to which the personnel are accustomed.

#### Separation from the Environment by Reduction of Stimulation

The well-known McGill University studies, by Bexton, Heron, and Scott (5) (See also Heron, 26) on sensory deprivation fall in this category. These and other related studies have produced impairments of behavior by reducing markedly the patterning or variability of sensory stimulation. Lilly (16), at Bethesda, carried out related studies by reducing the absolute intensity of stimulation. The explanation of such phenomena is neurophysiological. It is believed that the arousal mechanisms of the ascending reticular system are fired by continual, varied sensory input (5).

Freedman and Greenblatt (20) have found that perceptual distortions and hallucinations seem to be most directly related to a lack of patterning or absence of order and meaning. Thus a homogeneous visual field, regardless of its intensity, seemed to produce cognitive effects. Greater perceptual distortion occurred with diffuse light than with a blacked-out visual field.

Holt and Goldberger (27, 28) compared the effects of 100 gamma of the psychotomimetic drug, LSD-25, with those of 8 hours

of perceptual isolation. They found that LSD "produces a state subjectively more striking and qualitatively different from the effects of 8 hours of isolation." In addition they investigated the personological correlates of reactions to perceptual isolation, using a wide range of tests and clinical Q-sort ratings.

Levy, Ruff, and Thaler (35) kept men inside a soundproof dark chamber containing a bed, chair, refrigerator, and chemical toilet for up to seven days. Tests of intellectual functions showed no decrement, although the men reported less interest and motivation in thinking. No unusual perceptual phenomena were reported.

Jones and Goodson (31) were concerned with the effects of boredom on suggestibility in a situation which they described as follows: "Each cadet in the isolation group was seated in a narrow stall, 2 feet wide and 3 feet deep. No matter where he looked, forward, backward, up, down, or to the side, he saw only blank walls. The separation between the hard wood bench on which he sat and the table top on which he rested his head and arms was so slight that he couldn't stand up without stepping out of the stall, which he was forbidden to do."

The subjects were kept in these surroundings for approximately eight hours and then tested individually for suggestibility by means of the Hull body-sway technique. The results indicated that the isolated subjects were more suggestible, and that these findings could not be attributed just to muscular immobility.

It should be clear that the three aspects of isolation which have been discussed, (1) confinement to a limited space, (2) separation from valued stimuli, and (3) separation from the environment by reduction of stimuli, are not mutually exclusive. In many situations all may be operating simultaneously with cumulative effects. All three may occur at Alaskan AC&W sites, but effects directly attributable to such stress have not been evaluated in the field.

### SECTION 3. COLD STRESS

As indicated by Washburne (47), much of the work in this area has been from a medical-biological standpoint. Adams (1, 2) has provided a useful discussion of the physiological, neurophysiological, and endocrinological principles involved in the control of body temperature and Carlson and Thursh (9) compiled a selected, annotated bibliography of material on human acclimatization to cold. Studies by Davis and Joy (12) appear to demonstrate that man can adapt physiologically to cold. These authors believe "cold adaptation can be artificially induced at a faster rate and to a greater degree than naturally occurring cold acclimatization, that acclimatization in clothed individuals is similar in rate and degree regardless of ambient environmental temperature, that heat acclimatization does not affect either artificial or natural cold acclimatization, and that artificial cold acclimatization is retained through the summer months while seasonal acclimatization is not."

Debons (14) investigated the psychological characteristics of frostbite cases occurring during "Operation Sweathriar" in the winter of '49-'50. His results support the belief that the casualties were incapacitated to perform effectively in the field, possibly due to underlying psychological conditions. Subjectively, the Frostbite casualty was characterized by his associates in the field in such terms as "did not do anything to help himself," "just forgot all he learned," "refused to do what others did," and "was less active than others." Debons concluded that: "These indications are consistent with the Opinion Questionnaire results typifying the Frostbite case as an individual resistant to change and categorized, according to the work by this laboratory in adjustment, as Non-Adjusting to Alaska."

Blair and Gottschalk (7), working with the Army Medical Research Laboratory at Ft. Knox, Kentucky, used a specially constructed "cold room" to test four young Signal Corps operators for the operation of radar, radio, and switchboard equipment at low temperatures. Even though the subjects wore special kinds of clothing

and mittens, efficiency on the radar apparatus dropped to 75 per cent at  $-25^{\circ}\text{C}$  and to 50 per cent at  $-39^{\circ}\text{C}$ . Radio and switchboard operation efficiency was even lower.

Dusek (16) used a similar cold room at the Army Quartermaster Research and Engineering Center at Natick, Massachusetts. Eighteen barehanded subjects were given tests of manual dexterity in temperatures ranging from  $35^{\circ}\text{F}$  to  $55^{\circ}\text{F}$ . Fine finger dexterity was especially susceptible to cold, but gross hand movements were less affected. Teichner and Wehrkamp (45) found that hand-eye coordination is also affected by cold.

Few studies have dealt with the effects of cold on intellectual functioning. Blair, Urbush, and Reed (8) used questionnaires to obtain impressions of possible changes in reasoning power and memory from 78 Army enlisted men who had been stationed at Ft. Churchill, Canada for four winter months. Fifty-nine out of the 78 reported no change in "reasoning power," and 57 reported no change in memory.

Fine and Gaydos (19) studied the relationship between individual personality variables and body temperature response patterns in the cold. Their subjects were placed in a cold room at  $50^{\circ}\text{F}$  and then observed during recovery at  $78^{\circ}\text{F}$ . Changes in rectal temperatures served as a measure of rate of physiological recovery. Individuals with certain types of Minnesota Multiphasic Personality Inventory scores were found to take longer to recover normal temperature than did others.

Apparently, fine manual dexterity is impaired by intense cold, even with special clothing and mittens. However, cold does not appear to be a serious threat to adjustment for the majority of military personnel.

## SECTION 4. STRESS

The literature on stress is highly contradictory and confusing. There is hardly any agreement on definition of the term. Environmental stress, in the context of this report, refers to disturbing effects on individuals or groups resulting from their interactions with particular aspects of the environment. The concept of stress emphasizes the interaction of the organism and environment. Neither physical aspects of the environment, such as intense cold, nor psychophysiological states, such as fear or anxiety, separately, define stress, which reflects the joint contributions of both. The reactions of people or groups of people to disturbing characteristics of the environment, and the effects of such reactions on their performance of normal duties, are of primary interest in the study of stress.

Harris, Mackie, and Wilson (25, p. 28, 40), among others, have pointed out the considerable variation in conceptualization of performance under stress as used in current experiments and theoretical writings. Their argument includes the following which highlights some of the difficulties involved in a meaningful definition of stress:

"It is possible that a high level of performance may be maintained under stress but at a considerable cost to the organism. For example, a soldier may perform efficiently for long periods of time under combat stress while marked changes in his physiological functioning are occurring. The eventual result of stress may be a sudden and complete breakdown, a loss of the ability or the will to perform at all. For this reason, it would seem to be quite important to sample behavior on several dimensions (performance, personality and physiological) to detect possible interrelationships among responses and to observe it under relatively long-term stress

conditions. . . .Of all the stress studies cited, only one finding appears sufficiently consistent to be generalized: Some people are better able to withstand stressful conditions than are others--there are wide variations in individual reactions to stress. "

An interpretation that we favor is that "Stress reactions are best explained by reference to the concepts of stress as the pressures imposed on or perceived by the individual and strain as the reactions, physiological and psychological, of the individual to the stress. Such reactions are characterized by generalized homeostatic mechanisms; that is, the individual constantly strives to maintain himself in a comfortable, balanced state. This is done by adapting (adjusting) to stimuli, either within himself or in the environment, which disturb his comfort, balance or equilibrium. Stress stimuli differ from other disturbing stimuli primarily in their severity, suddenness or duration" (43).

Chilcs (11) presented an interesting attempt to consider stress in terms of the psychological framework developed by Brown and Farber for an analysis of the approach-avoidance situation, and Miller, Bouthilet and Eldridge (37) compiled a useful bibliography for the development of stress-sensitive tests.

However, Gorham and Orr (22), Harris, Mackie, and Wilson (25), and others have found the stress research literature confused and contradictory. The latter reviewers, in a critique of studies investigating the effect of stress on performance, expressed the view which most critical reviews of the stress and fatigue literature have accepted. There are indeed wide variations in individual reactions, but the factors that account for these, particularly within the range of normal, well-adjusted individuals, are difficult to pin down.

Holtzman and Bitterman (29) concur on the importance of individual differences in response to stress. They noted that "Published reports indicate that while nearly all flyers experience some anxiety before and during combat, the intensity of this experience

varies greatly. Furthermore, under strong emotional tension some individuals are capable of more effective control of behavior than are others who soon become badly incapacitated."

Applezweig and Moeller (4) proposed that a meaningful approach to an understanding of psychological stress is through an evaluation of individual motivation. They conceived stress as an environment-person interaction, dependent upon both the situation and the person. Their view is that: "Stress research concentrating on the environment alone might produce only deceptive generalizations about what situations might be stressful to most people. It might be more fruitful to ask what situations might be damaging to what aspirations or values or motives held by persons possibly subject to exposure to these situations." They argued that analysis of both motive systems and the behavior modes developed to serve them is necessary.

A similar view was advanced by Lazarus, Deese, and Osler (34), who concluded that:

"The successful understanding of an individual's performance under stress depends upon some way of measuring the kinds and strength of his motivations and relating them to the characteristics of the situation in which he must perform. The fulfillment of this aim, is, indeed, no simple affair."

In laboratory investigations, Deese and Lazarus (15) found that well-learned habits are more resistant to the adverse effects of stress than are poorly learned habits. In this connection, Sells (43) noted that: "Prior experience in meeting emergencies, even simulated practice emergencies, together as a team and training and practice together under a wide range of situations gives every member of the group many advantages to help face new problems." A particular advantage mentioned by Sells, as an outcome of training in working together as a team, is that: "Each man has developed a set of expectations which enable him to anticipate who does what, when and how to give and receive relevant information economically and meaningfully."

Similarly, Torrance (46) observed that "Under stress, these linkages between members may become confused and thus people do not have a clear perception of what they can expect from one another, with whom they can relate, how they can relate to one another, and so on." Students of both civilian disasters (Wolfenstein, 49) and military emergencies and extreme conditions (Torrance, 46) have recognized the importance of overlearning through rehearsal and practice, particularly of emergency procedures. This conclusion was also emphasized by Biderman (6), after the Korean War: "One possible lesson from the military experience is that training and information can create a general disposition to act in a crisis--to attempt to cope with the crisis. Here, the contributions of training were quite manifest statistically among the Air Force Korean group . . . The escape traditions of the RAF as well as of the USAF in World War II, also illustrate how the disposition to act in crisis can be developed."

In addition to demonstrating the importance of training as a factor in coping with stress, many of these studies may be seen as showing the importance of group support. Popular expressions, such as strength in numbers, strength in unity. "United we stand; divided we fall," and "A house divided against itself cannot stand", reflect this also.

Torrance had approximately 200 interviews conducted with Air Force personnel who had been downed over enemy territory during World War II or the Korean conflict. Approximately 1,000 critical incidents were abstracted and analyzed to develop hypotheses concerning effective and ineffective functioning under actual survival conditions. Group structure seemed to be one of the more important factors involved in such stressful situations. "It appears that the capacity of a group to survive depends in no small part upon its skill in organizing its efforts."

On this point, Sells wrote that: "When men function as a team, instead of milling about like a disorganized mob, they have more strength, skill, ingenuity, stress tolerance and stamina than any of them individually and their odds against failure are multiplied many fold. The plan and goal of the group gives a plan and goal to every man. The eyes and ears of many see for all."

The stresses involved in the survival situations differ from those which are brought about by the isolation and cold of the remote sites. Washburne (47) spelled out these differences beautifully in his concept of the passive defender. Basing his observations on personnel interviewed at antiaircraft artillery (pre-Nike) sites in Greenland and Alaska, he noted that:

"Soldiers at such stations are not faced with frequent crises. Rather, their existence is marked by monotony and seeming purposelessness. Like other soldiers, they are there to meet crisis when it comes. The difference is that crisis does not come to them in peacetime and their lot is to wait and to watch. . . . Passive defense, with its vigilance tasks and its monotony, certainly offers different stresses and different rewards from those offered to the soldier in the field."

Ewart (18) discussed similar factors as being involved potentially at ballistic missile sites. It is a plausible hypothesis that leadership and effective group organization will be beneficial in meeting these chronic, more subtle stresses, as well as those stresses involved in survival situations.

## SECTION 5. RESULTS OF MORALE SURVEYS AMONG PERSONNEL EXPOSED TO ISOLATION, COLD, AND STRESS

Washburne (47), generalizing on the basis of five large-scale surveys of human adjustment problems in the northern latitudes (carried out at the Arctic Aeromedical Laboratory), concluded as follows: "In general, the studies revealed that most of the maladjustment to life in Alaska was related to dissatisfaction with the manner in which certain services were provided for the men and their families; men complained, for instance, of the lack of interesting things to do, inadequate social outlets, and lack of faith in the Air Force system of military law."

Gross and Miller (24) explored the impact of isolation on worker adjustment at military installations in both the United States and Japan. Recreation, both on and off the site was found to be a serious problem at isolated sites situated in both countries. They stated that: "The military installation which provides a varied recreational program and relates itself to the local community builds a miniature society. Without the rudiments of a full social life, civilian soldiers will not be likely to achieve high morale on protective or occupation assignments. The consequences may be exhibited in low site efficiency and a low re-enlistment rate. Leisure problems, in this context, should receive top priority at all Command Levels."

According to McCollum (38), the recreational aspects of Alaskan duty have received undue emphasis as "morale" determinants. An anonymous survey questionnaire administered to airmen at eight Alaskan USAF bases found that no particular sport engages more than 17 per cent of the airmen, while vicarious escapes (e.g., reading, movies) were overwhelmingly supported by the men. Over 17 per cent of the men registered the feeling that "things on the base were generally 'messed up'."

Debons (13) administered a 20-item questionnaire to 485 Army and 360 Air Force personnel after the joint ground-air defense training exercise "Dutch Door". Of the total sample 25 per cent were critical of their leadership.

According to Edgerton (17), "There is evidence in the literature on leadership in the Arctic regions that psychological adjustment in this region is not governed by the severity of the cold itself, but relates to the success or failure of leadership provided by officers in dispelling effects of isolation which the cold produces. When there is good leadership at a base, even very poor living conditions appear to have no serious effect on the morale of the men. One study was made at a base in which there were very good living conditions; however, the leadership was poor and the morale was low. This base was compared with another one which had very poor living conditions but good leadership and the morale was high. . . . Administrative policies are of great importance in keeping morale high in cold weather operations."

The finding that environmental variables do not necessarily relate to behavior in a one-to-one manner should perhaps not surprise us. The Western Electric studies by Roethlisberger and Dickson (39) at the Hawthorne Works in Chicago have furnished a precedent for this finding. They investigated the effects of factors such as temperature, humidity, and illumination on production, and found that within a wide range of values these variables are secondary to human relations factors.

Perhaps it should be re-emphasized also, that most of the work cited is more applicable to "passive defenders" rather than to troops under field conditions. They may be located at a longitude and latitude involving quite low temperatures, but characteristically, they do not have to be exposed to such temperatures for very long. Their actual working and living conditions involve comfortable temperatures. Man does, after all, mold the physical environment to make it more suitable for him.

Isolation, in the senses of confinement to a limited space, separation from valued stimuli, and to some extent separation from the environment by reduction of stimulation, would still be present even under comfortable temperatures. Likewise one might argue that the threat or possibility of exposure to the unfavorable ecology would be present even under comfortable temperatures, thus providing a chronic source of anxiety or threat. We indicated earlier the hypothesis that leadership and effective group organization may be found

to be of benefit in meeting such long-term, subtle stresses, as well as the stresses involved in an unusual crisis. The previously cited finding of Edgerton that "When there is good leadership at a base, even very poor living conditions appear to have no serious effect on the morale of the men" may be seen as supporting this hypothesis.

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<p>Arctic Aeromedical Laboratory, United States Air Force (AFSC), APO 731, Seattle, Wash. Rpt. AAL-TDR-62-33. MILITARY SMALL GROUP PERFORMANCE UNDER ISOLATION AND STRESS -- CRITICAL REVIEW. III. ENVIRONMENTAL STRESS AND BEHAVIOR ECOLOGY. June 1962. 23p., 50 ref. Unclassified Report</p> <p>A critical research review of behavioral effects of isolation, cold, and general stress, with particular reference to AC&amp;W sites in Alaska. On the basis of the literature, environmental stress does not appear as a major threat to adjustment of troops stationed at AC&amp;W sites. Human engineering has contributed greatly to the comfortization and control of the environment, and there appears to be a wide difference between conditions of the area and conditions of the specific work and living environment, except in cases of emergency. The</p>	<ol style="list-style-type: none"> <li>1. Military Psychology</li> <li>2. Stress (Psychology)</li> <li>3. Behavior</li> <li>4. Alaska</li> <li>5. Bibliography</li> <li>I. Project 8243-11</li> <li>II. Contract AF41(657)-323</li> <li>III. Texas Christian Univ., Fort Worth, Texas</li> <li>IV. Braun, J. R. and S. B. Sells</li> <li>V. Available from OTS</li> <li>VI. In ASTIA collection</li> </ol>
<p>possibility of such emergencies may be a threat, but few have occurred. The positive values of motivation, training, and group dynamics (including leadership) as factors which offset the disorganizing effects of environmental stress are pointed out.</p>	

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